1
0001,000 - 0005,000
[silence]
2
0005,000 - 0014,000
The objectives for this webinar are to give you a general introduction to coating, so you understand the materials that you're inspecting just a little bit better.
3
0014,000 - 0033,000
Reclamation focuses on safety first, so we'll talk a little about what you should do when you're planning for a trip, things to consider, and then we'll move on to the actual tools that you might be using for an inspection or an assessment. I do use those two words interchangeably.
4
0033,000 - 0050,000
Then we'll move on to actual field conditions, I'll give you some photographs of structures and try to point out some of the problem areas, some things to look for, and then look at two specific types of coating and some of the issues we see with them.
5
0050,000 - 0104,000
Then we move into the actual maintenance options, and these are things that you should be thinking about while you're doing inspections. They may help guide you as to what type of documentation you want to take during the inspection.
6
0104,000 - 0110,000
Then we'll talk a little bit more about developing a maintenance plan and strategies for doing so.
7
0110,000 - 0128,000
This webinar is loosely based on an article that was written for the "Journal for Protective Coatings and Linings" last year. I was the first author on this paper. I had a lot of assistance from my other coating colleagues here in Denver.
8
0128,000 - 0142,000
We actually won an award for it last year from that organization. If you want to get a little bit more of a solid picture, aside from this webinar, that may be a good reference to seek out.
9
0142,000 - 0159,000
First, I want to start with an introduction to paints and coatings. I did a quick search on "Wikipedia" and it tells us that people have been using materials that you could consider paints, for as long ago, as 100,000 years ago.
10
0159,000 - 0218,000
Today's paints and coatings, the ones that people are most familiar with, are the ones that are inside of your home. These are typically a latex water-based paint now. Other paints that you might see, or coatings that you might see, are concrete sealers. There's a lot of people using these in their basements or perhaps on a driveway now.

11
0218,000 - 0239,000
We're going to talk about protective coating. These are different because they have much higher performance, much more robust properties. Mainly, there are two properties that exceed those other paints and coatings: A Strong adhesion to the substrate and a controlled penetration of water and ions.
12
0239,000 - 0250,000
This is basically saying that it's a barrier to the environment. We also want strong adhesion, a bonded coating to the substrate, to prevent the lateral movement of water and ions.
13
0250,000 - 0307,000
The main goal is typically for protecting steel substrate. We're trying to prevent corrosion here, but we also recognize that we use coatings occasionally on concrete at Reclamation too.
14
0307,000 - 0318,000
For protective coatings, there are two main classes. These are more technical terms, but I'm going to give them to you anyway here. Those are thermoplastic and thermoset.
15
0318,000 - 0340,000
A thermoplastic material, as the word plastic within it implies, it's basically a material that can be melted or reshaped. When these materials form, they are basically just drying. There's a solvent with them that's evaporating. Examples of these are vinyl, coal tar enamel, and latex paint.
16
0340,000 - 0359,000
A thermoset coating is a material that sets or cures. There's always a chemical reaction. One way to tell if you are working with a thermoset or thermoplastic, is the number of containers of paint that you have in front of you. If there are two containers, it's certainly a thermoset.
17
0359,000 - 0415,000
Those materials are reacting together. After that chemical reaction takes place, you have a different material. In many cases, it would be an epoxy, a polyurethane. A coal tar epoxy is also a thermoset. An alkyd is also a thermoset.
18
0415,000 - 0436,000
We have a few exceptions listed here for thermoset materials that are only in one container. Those are moisture-cured urethanes, moisture-cured siloxanes, and alkyds. In these cases, they are reacting with something in the atmosphere. There still is a chemical reaction taking place.
19
0436,000 - 0513,000
The other thing that I point out on this slide, is that a paint or a coating is really three components. You have the binder, or the polymer, typically an organic material. You also take pigments or fillers and add them to that binder. You always have some sort of a solvent or diluent that you add to this to make this a thinner material, a thinner liquid, so

that you can transfer it and apply it to a substrate. If you are going to spray it, same thing. You want to make sure you have solvent in there, so you can apply it and it will wet the surface and it will self-level.
20
0513,000 – 0531,000
We have a few photos here on the right. The first one is sort of implying a barrier coating. This is the type of coating that we are using at Reclamation most commonly nowadays. We are simply relying on the polymer material, the binder itself, to be a barrier to water and ions.
21
0531,000 – 0553,000
We use materials that are high film build, coal tar enamels. An example, we are using higher film build polyurethanes now. Some epoxies can also be pretty high film build. This higher film build just helps to increase the length of time it takes for that water to penetrate through the coating to the steel.
22
0553,000 – 0620,000
There are also barrier coatings that utilize flake pigments. These flake pigments, when formulated correctly, will line up parallel to your substrate. They act as a barrier to water and ions again there. They make the pathway for water and ions much more tortuous. The photo on the right bottom corner is meant to demonstrate that.
23
0620,000 – 0642,000
Two other types of coating systems are sacrificial coatings, these include zinc rich primers, any type of metalizing or galvanizing. Here you have a metal that is more active up against the steel or whatever substrate you're protecting. It's sacrificing itself to protect the steel.
24
0642,000 – 0701,000
Another type of coatings are inhibitive coatings. These contain pigment, such as lead or chromate. However, we cannot use lead or chromate, or many of those similar types of pigments that we used to use for corrosion protection, as they have health hazards.
25
0701,000 – 0715,000
This slide shows some of the coatings that were used historically by reclamation. Coal tar enamel was a big one for lining pipes, particularly penstock pipes. We typically saw 50-plus years of service with that.
26
0715,000 – 0729,000
We still have plenty of this material throughout reclamation. We're doing what we can to try to maintain it as well as we can, because we know that it provides a much longer service life than other materials that we're replacing it with.
27
0729,000 – 0747,000
The coal applied, coal tar paint, the CA-50, we see in penstock tunnels on the exterior of a penstock pipe. The photo on the lower left shows an example of a penstock tunnel and the pipe is on the bottom and the black CA-50 paint on there.
28
0747,000 – 0815,000

The red lead primer, plus the aluminum phenolic topcoat, was another commonly used system. We used this more in an atmospheric exposure. The photograph on the right is a similar type of system. It's a phenolic lead-based paint for the primer, and then phenolic aluminum topcoat. This structure was receiving UV light degradation. That's why you see some of the spotting on the top.
29
0815,000 – 0838,000
Vinyl resins, there are a number of different types, the VR-3, VR-6, and the VR-M, which is a mastic paint. We typically use those in exposures that are for intermittent immersion. They spend part of the time underwater and part of the time exposed to the air. The radial gates in the lower right-hand corner is an example of a VR-6 paint.
30
0838,000 – 0901,000
There is a type of coal tar, called coal tar epoxy, that's a derivative of coal tar enamel. Instead of it being an enamel, it's an epoxy binder. This is a more conventional paint. It's similar to epoxy because it has the epoxy binder. Some of that is still in use today.
31
0901,000 – 0927,000
Moving on to planning for a safe inspection. You want to be sure that you have all the certifications that you need. Whether you are traveling to another facility, or a facility that you're familiar with because you work there every day, make sure you stay up to date on fall protection, confined space and lock out tag out. We now call that hazardous energy control program.
32
0927,000 – 0947,000
In preparing a job hazard analysis sheet, I also have some things listed here you might want to consider. Whether you do work at the facility, or you're traveling to facilities, still always good to review these items before you go and start that work.
33
0947,000 – 1016,000
Here's some photographs showing some of the inspection conditions that we see when we go out and perform inspections. The two photographs on the left are for an outlet pipe. Part of the outlet pipe was underwater. That made the inspection difficult. The other part of it was partially filled with sand, then the walls were full of mud. Those are challenges that you might be able to forecast before you begin your inspection.
34
1016,000 – 1026,000
We've seen inspections where the walls of the pipe were brushed down with water and cleaned up so that it was easier to see the condition of the coating underneath.
35
1026,000 – 1041,000
In the center is a tainter gate structure for the Army Corps of Engineers and this is obviously over waterway. You want to be sure that you're using fall protection or rope access techniques to be safe.
36
1041,000 – 1105,000

On the right is another photo from a radial gate structure. This structure had a poor design. The holes that you're seeing on the top right corner are the drain holes that were designed. However, in the resting position the drain holes are at higher elevation than the other end of that internal compartment.
37
1105,000 - 1129,000
They were intending to have the water drain from within the radial gate, but because the drain holes were on the wrong side, they ended up with a lot of standing water. When we did our inspection we found that those drain holes were corroding quite badly, and really everything on the internal floor was severely degraded.
38
1129,000 - 1155,000
Moving on to the field inspection equipment and techniques, there are several types of inspection surveys. The first one is the simplest one. It may take you a few hours to complete, and I personally like to do this type of an inspection for any inspection that I go on. To start the day out, I just needed to familiarize myself with the structure.
39
1155,000 - 1205,000
We have to identify the type of coating, the general condition of the coating, and then think about whether or not more documentation is needed.
40
1205,000 - 1219,000
There is the ASTMD610, listed here. That is a pretty good standard to use for giving a rust rating to the coating to try to determine the degradation of it.
41
1219,000 - 1226,000
This is a good method if you just need to get a quick determination of the severity of the condition.
42
1226,000 - 1236,000
We typically move ahead then and do a more detailed visual survey and you can consider that a semi-quantitative type of survey.
43
1236,000 - 1246,000
Here you're doing a more systematic approach and looking at all the different structural elements of the piece of equipment or whatever it is that you are tasked to inspect.
44
1246,000 - 1305,000
You might be looking at the support beams separately from other things, the edges and that. What we try to do in these inspections is for each of those structures document different things. You might take some film thickness measurements.
45
1305,000 - 1325,000
If you find any areas that have reduced film thickness, be sure to document that, and if you're not familiar with what the thickness should have been, then this means that you are probably taking more measurements, perhaps, throughout the structure, and if you notice that any areas are thinner than others, make sure to document that.

46
1325,000 - 1354,000
Any areas that have more severe coating deterioration, you'll want to document. Then you can start to think about why it is deteriorating faster there. Does the water change directions quickly? Is this some other engineering reason that the coating is not holding up there the way it is in other areas? We always have issues with coatings on edges, so that's always a problem area for us, but we do still want to document that.
47
1354,000 - 1418,000
Then in particular if you see rust on a flat surface, try to document that too so we can try to determine, why that may be. Then always when you're performing an inspection on metal work equipment, be sure to document any areas where you are seeing severe pitting or other general corrosion and metal loss.
48
1418,000 - 1434,000
There is also one additional level of physical inspection survey. This is one where you employ more destructive methods to determine the physical properties of that coating. Here we have listed a few different types of adhesion testing.
49
1434,000 - 1505,000
You can measure the film thickness using a Tooke gauge. The photo on the left is a Tooke gauge and it has a little steel knife on it. One edge of the knife is perpendicular to the steel substrate and the other edge of the knife is at a defined angle. So it takes a cut out of that and if you look at it, you turn the Tooke gauge up on its end and then there's a microscope and you can look through the microscope and then there are gradations.
50
1505,000 - 01523,000
If you have a couple of different coats of paint and those coats of paint are different colors, you'll actually be able to see the different layers, and you can measure the film thickness using the gradation tool. You measure film thickness, and also the number of coats.
51
1523,000 - 1544,000
The photograph on the right is a type of adhesion test and it's basically just cutting an X onto that painted surface and then applying a piece of tape and pulling that tape off. The bottom part of that photo shows a piece of tape before it was pulled off, the top part shows a piece of tape after it was pulled off.
52
1544,000 - 1553,000
This is a very poor adhesion, the tape pulled all of the coating off. That is not what you want to see if you're doing a survey.
53
1553,000 - 1603,000
The other thing you do during this type of inspection is sampling for paint-chips for hazardous materials testing. We'll talk more about this later.
54
1603,000 - 1620,000

I have also included on this slide a few helpful hints for performing an inspection. If we're going into a pipeline, and we need to walk long distances, we spend a lot of time holding a light source close to the pipe wall, and sort of moving that up and down the pipe wall.
55
1620,000 – 1634,000
What we are doing is scanning for any shadows that show up. If there's a shadow, it either needs to be some sort of dust or debris, but if it is a round shadow it is typically a blister. We go in and investigate that further.
56
1634,000 – 1652,000
If you're investigating the interior of a pipe that has a coating on it that’s a more conventional coating like a polyethylene or an epoxy, it might be somewhat common to see blisters and basically what you’re doing is characterizing the amount of blistering that you're seeing.
57
1652,000 – 1704,000
It is OK to see some blister here or there but if you are seeing a lot of blisters in an area, or just is a lot of blistering in general, you would want to document that very well.
58
1704,000 – 1733,000
Another tool that coating inspectors use is an inspection mirror. They are typically a long handle, small mirror. You can buy one of these or construct one of your own. Those are typically handy for trying to see around corners or other hard to reach areas. It is also good to have a good camera or a set of binoculars if you want. This allows you to see distances close up.
59
1733,000 – 1754,000
We've been in penstock pipes at Grand Coulee and they’re 45-foot diameter. They are very challenging to see the coating condition on the wall, the feeling of that pipe. A good camera with a good flash can get you a pretty good photo of that surface.
60
1754,000 – 1811,000
Here, we've listed a bunch of references that we feel are useful. The first couple are more general and then we get into some pretty specific measurements that you might use for more destructive testing or more critical analyses.
61
1811,000 – 1817,000
Moving on to assessing coating condition and giving examples of that.
62
1817,000 – 1835,000
When you're performing a maintenance inspection, here are some things to consider: Have there been previous repairs to this coating system? Are there documented problem areas? Are there construction challenges that you would foresee assuming that you go forward with the maintenance?
63
1835,000 – 1852,000
In hydroelectric power plants, they typically have limited outage periods. They're working in confined spaces and sometimes we have to deal with

water seepage and how we can control that in a manner so that we can paint on a dry surface.
64
1852,000 – 1912,000
You also want to assess the condition of the coating. First, you're looking for visual defects, and then you want to take more types of documentation as necessary such as the film thickness or the ultrasonic thickness testing, which evaluates the thickness of the steel pipe itself.
65
1912,000 – 1915,000
Then, there is hazardous material testing again.
66
1915,000 – 1935,000
There are three basic service conditions. Atmospheric, burial or immersion. We typically throw in another one and we call it intermittent immersion. This is like a radial gate structure that spends part of the time in the water and part of the time out of the water.
67
1935,000 – 1953,000
When considering maintenance options, we're typically thinking about the potential maintenance while you're on the inspection. You'll often find that there are several options that may be feasible so it's important to think about what these may be and incorporate that into your inspection as you're doing it.
68
1953,000 – 2011,000
If you can, it may be important to do this even before the inspection begins but include funding perspective from the facility owner. You may already know that one option that should be feasible is not economically feasible for whatever the current funding situation is.
69
2011,000 – 2026,000
If you ever think that you're going to be performing maintenance especially if it's a full recoat or something pretty serious that’s going to go out for a contract to do the work, collect a sample for hazardous materials testing.
70
2026,000 – 2030,000
Here are some common adverse conditions.
71
2030,000 – 2044,000
The photo on the upper left is an example of chalking. We see chalking on virtually any paints or coating that is not UV-resistant that is applied into an atmospheric exposure condition.
72
2044,000 – 2102,000
At the center, we have cracking on a coating. We see cracking with coatings that lose elasticity over time. This is a general degradation procedure that tells us that the coating is starting to fail.
73
2101,000 – 2111,000
At the right is blistering and these are some of the more common types of defects that people are familiar with. They're typically a rounded shape.
74

2111,000 - 2121,000
There are several different causes for blistering but the end result is always the same. You have an area that's unbonded coating.
75
2121,000 - 2143,000
At the bottom, we're showing two different types of degradation. On the left is a uniform degradation and we're starting to see rusting coming through throughout that painted surface and on the right is a degradation of mild steel to the right of a stainless steel piece of equipment.
76
2143,000 - 2201,000
Here, we have dissimilar metals that's accelerating the degradation of the mild steel and the coating on top of it as well. Typical problem areas, anywhere that you see that you have drips, whether this is in a penstock tunnel or a gallery or something similar to that.
77
2201,000 - 2209,000
If you have water that's dripping down onto a coating, you're going to see blistering or some sort of degradation of that coating eventually.
78
2209,000 - 2225,000
It will wear away much quicker than it does any of the other areas of the coating there. On the right, we're showing a trash rack and we almost always see degradation of the coating at the water line first for a trash rack or any other structure that's in the water.
79
2225,000 - 2245,000
On the lower left, we're showing a picture of a pipe that's entering a concrete wall and here there's a water spray around the leaking seal. This semi-humid and sprayed water environment degrades the coating much quicker than just a dry atmosphere environment does.
80
2245,000 - 2313,000
On the lower right, we're showing a turbine runner at the top with the draft tube below. The upper section of the draft tube, we typically call throat ring. Both of these areas, we have much quicker coating degradation, they’re high cavitation zones, they have erosion damage also. All those contributing factors tend to degrade the coating in this area much quicker.
81
2313,000 - 2339,000
To give an example of a specific type of coating system, here’s the coal tar enamel. As I said, we still see a lot of these in Reclamations penstocks as a liner. The top picture is showing what we tend to see early on or midway through the degradation process for coal tar enamel. This is a type of material that is a thermoplastic.
82
2339,000 - 2357,000
It does lose its elasticity over time. There are plasticizers that are added to the paint when the paint is applied, but over the years, the plasticizers seep out of the coating itself and we see a much more brittle type of failure for it.
83
2357,000 - 2414,000

Sometimes we call it alligator cracking when it has this sort of shape to it, but if you're looking at the surface of a coal tar enamel paint, you will often see cracking or micro cracking but you won't see any visible corrosion through that coal tar enamel.
84
2414,000 – 2431,000
As we perform our inspections, when we see that there is some cracking on the surface of coal tar enamel, we document that and we try to give it a general description. Is it really fine cracks? Does it look the cracks are almost all the way through the paint to the seal?
85
2431,000 – 2447,000
That's really important because we found that the cracking is the initiation of the degradation process for coal tar enamel. If you see that it's starting to crack, all you need to do is observe that as you're passing through the years of time.
86
2447,000 – 2507,000
Once you start to see the corrosion seeping through these cracks as we do in this upper left photo, then that's an indication that that area no longer protects the substrate the way that we want it to. As long as you see cracks in your coal tar enamel, but there's no rust coming through yet, we're typically OK with that.
87
2507,000 – 2514,000
The picture at the right shows a different situation and type of failure that we see with coal tar enamel.
88
2514,000 – 2538,000
Coal tar enamel likes to stay cool and damp so the structures that are running penstocks through a tunnel tend to have coal tar enamel linings that last for many, many, many decades. Any coal tar enamel penstocks that were above ground would crack due to the heat changes throughout the year and the stress applied to the coating from that.
89
2538,000 – 2553,000
In this example it’s a penstock that was above ground and then enters into the soil. There's pretty extreme heat differential there and we see cracking of this sort, in those areas.
90
2553,000 – 2614,000
The two lower photos show the brittle behavior of coal tar enamel. It has difficulty with transitions and shape. Rivets often show failure around them early on and there's corrosion at a joints in the photo on the right.
91
2614,000 – 2624,000
Moving on to a conventional coating. Epoxy coatings are used quite frequently now for new coating systems throughout reclamation.
92
2624,000 – 2637,000
Unfortunately, we don't see the same service life that we have with coal tar enamel and some of those other older systems. We're finding that it's maybe 20 or 30 years tops depending on the service environment.
93

2637,000 - 2645,000
When performing an inspection, you may see that the typical condition of the structure, we use the lower right photo for instance.
94
2645,000 - 2702,000
You might see some rust staining throughout, but very little. Maybe you could characterize it as three to five percent corrosion. What typically happens as you look around in other portions of the structure is you see areas that require maintenance very soon.
95
2702,000 - 2723,000
The photo on the left is an area that we've come to assume had some issue with the original painting, either they missed a coat of paint or the coats of paint were too thin, something that caused that coating not to perform the level of service life that we would have expected.
96
2723,000 - 2753,000
The two photos on the top are other problem areas. The bolts are rusting and we found that these are galvanized bolts, which is probably more of a material selection challenge but during an inspection, you need to document any areas where you're seeing corrosion and document it well enough. If you can't solve the problem on the site, you have that information that solves it later on or have someone else help you solve it.
97
2753,000 - 2757,000
Hazardous materials sampling.
98
2757,000 - 2822,000
We just have few slides to briefly provide information for this. If you're going to be performing a collection or a sampling for hazardous material testing in the field, just be sure that you're protecting yourself. Assume that if you're taking a test sample that it does contain hazardous materials so wear the appropriate PPE.
99
2822,000 - 2841,000
Your two basic routes of entry are either through inhalation or breathing of dust and fumes or ingestion of the materials. So make sure you're protecting yourself to avoid both of those situations. When you're collecting coating samples, have a plan.
100
2841,000 - 2852,000
We'll talk about that more on the next slide and use the appropriate methods for collecting and make sure that you're having them tested at a certified laboratory.
101
2852,000 - 2904,000
The reason that we collect coating samples for hazardous material testing is because we want to be sure that we included much information in a coating specification or statement of work as possible.
102
2904,000 - 2920,000

The more information we have, the more detailed it is, the better bid you will get and hopefully that leads to the better job. By better bid, I mean more accurate assessments of the estimated cost of doing the work.
103
2920,000 - 2942,000
Never assume that any level is too low to include in the contract. Even if you have a non-defect, still include that in the contract, include that paperwork from the laboratory. If you're reading the result and you see detectable -- detectable just means that it's any level above the method detection limit.
104
2942,000 - 3000,000
Here's an example of a sampling plan. Sample in several areas for each coating system and create a composite. In this example, we're showing that nine different areas were collected to form a composite sample.
105
3000,000 - 3018,000
That's probably more areas than you need to sample but if you're seeing that the coating structure looks like it may have different layers of paint, maybe underlying layers of primers in different areas, it may be important to at least collect in a few different areas.
106
3018,000 - 3034,000
As you're doing that, take a photograph or use a diagram or a drawing or something that you can use to document the sample location. That way, if there's any question, later on, you can be sure that you can go back and say where that sample was taken.
107
3034,000 - 3046,000
There's also a chain of custody procedure for handling these materials and the samples within the baggies, for shipping them, and those sorts of things. Be sure to follow that.
108
3046,000 - 3056,000
Listed a few methods here. These are the analytical methods. There's some from EPA, ASTM, and NIOSH.
109
3056,000 - 3106,000
The specific hazards that you're testing for. Some people make the mistake of just testing for lead or another specific metal that is known to be hazardous.
110
3106,000 - 3121,000
You really want to test for what's called the RCRA-8 metals. Those eight metals are listed here, all of them are regulated. You want to be sure that you're testing for all of them. We found situations where almost each of these have been on structures.
111
3121,000 - 3136,000
So, if you only test for lead, you may have had chromate or arsenic, and you may be missing that. That could end up being expensive on the tail end if any maintenance is done through a contract.
112
3136,000 - 3139,000

The non-metals that you want to test for.
113
3139,000 - 3200,000
Coal tar pitch is a carcinogen. It's the main ingredient in coal tar enamel, it's also used in coal tar epoxies. You want to test for that also. Asbestos and silicates are pretty well known hazards for asbestosis and silicosis ailments in humans.
114
3200,000 - 3217,000
Polychlorinated biphenyls are also what they call a percipient organic compound that exists in nature, never brakes down, and causes hazards for humans and other organisms.
115
3217,000 - 3235,000
This slide is included to provide information on the approximate sample size and cost for each of these. The first one is the RCRA-8 metals. You can see that approximately $150 per sample.
116
3235,000 - 3237,000
The asbestos testing.
117
3237,000 - 3250,000
Asbestos was typically used in coating plasters, putties, and caulks. So if you're doing construction or maintenance in any areas that include and of those types of materials, you probably want to sample those as well.
118
3250,000 - 3303,000
The size for that is two square inches. Make sure that you're including all layers and types of surfaces or coatings. Make sure that they are represented within that sample. Those tests are typically $25 a sample.
119
3303,000 - 3325,000
Then there are the PCBs, which was used in hundreds of industrial and commercial applications including as plasticizers, specifically in coal tar enamel, but also in other types of systems on reclamation structures. Also used as pigments and paint. The cost for that one is $80 to $140.
120
3325,000 - 3345,000
You can see here that any sample you send to a laboratory to do this thorough analysis, you're looking at $250 to $300 per sample. It may be worthwhile to think about your structures. See if there are like-structures that you're almost certain have the same coating material on them, perhaps if you have several gates.
121
3345,000 - 3356,000
If you think that it's the same coating, take a sample from each, create a composite sample and send that as one sample.
122
3356,000 - 3410,000
Here is some additional references for that, different websites to look at. If you're going to be doing any work, there is different levels of training offered by SSPC, which is the Society for Protective Coating.
123
3410,000 - 3431,000

Listed at the bottom of the page are two Bureau of Reclamation contacts, Allen Skaja or Kevin Kelly. These persons are a little bit more familiar with handling hazardous materials sampling and the ensuing specifications sections for them.
124
3431,000 - 3448,000
For the coating maintenance options, you can do no painting at all. This is either considered a deferral of maintenance or something that you would also do if you're planned to decommission. You're not going to be doing any more maintenance anyway, perhaps.
125
3448,000 - 3458,000
There are spot repairs. You can do a spot repair with a full overcoat. You can do a full removal and recoat. Then there are a couple of alternatives or additions.
126
3458,000 - 3521,000
You might be installing a cathodic protection system, or you might be replacing that piece of the structure or that equipment, either in kind or with some sort of plastic or composite. There are several options there. Each of these progressively increases in complexity the amount of work involved and the expense.
127
3521,000 - 3547,000
For deferral of maintenance, you may do this if the coating is still in good condition. You may also do it if the structure's service life is limited. It might not be worthwhile to apply a new coating. You may also do it if you have some degree of damage, but you think that in the near future you're going to surpass that spot repair level where it becomes more economical to just do a full recoat anyway.
128
3547,000 - 3607,000
You might just say that, "We're going to wait five more years, and we'll just schedule the full recoat." You may also do it if you already need a full recoat, but there are other structures that would be better served by having a quick touch-up paint or spot-repair. If it's better to allocate funds for that, you may make those decisions also.
129
3607,000 - 3619,000
If you ever have any contributing deficiencies such as leaks, seepage, or drips, it's always important to defer maintenance until you can control those.
130
3619,000 - 3636,000
For spot repairs, we typically do this when the amount of damage to the coating is less 15 percent of the surface area. Especially if you're in the region of three to five percent damage, we almost always spec out spot repairs for that.
131
3636,000 - 3656,000
We say if you're going to be estimating the amount of damage during your inspection, if you're doing a really good documentation where you're using stationing, if you're in a pipe you might be using stationing, you might

have rulers along with you so you can measure the distance, and exact locations of defects.
132
3656,000 - 3713,000
You can also, in doing that, estimate the square foot of repairs for each of the repairs that's needed. At minimum with these repairs, you need to add a few inches around the perimeter -- at least one or two inches -- so that you can feather the edges.
133
3713,000 - 3729,000
What we see sometimes is that some people think it is more beneficial to do a larger area repair. Sometimes it's more beneficial to just do the individual spots and keep the repair area as small as possible.
134
3729,000 - 3744,000
This photo is showing an example of that, where you have three little areas of damage in the middle adding to, I think it's approximately ten square feet in the middle. If you just do a larger area repair, you end up with 30 square feet.
135
3744,000 - 3753,000
10 square feet versus 30 square feet is not a significant cost difference, but it may be if you're doing this throughout a structure.
136
3753,000 - 3758, 000
A spot repair with full overcoats.
137
3758,000 - 3818,000
This is a type of maintenance painting that we typically don't specify. There are very limited applications for this. We will consider it for an atmospheric coating, or an atmospheric structure. But if we're going to do that, we need to be sure that the adhesion of the existing coating is very strong.
138
3818,000 - 3833,000
We'll use different test methods to test that adhesion. There's a crosshatch adhesion test on the bottom, so you're making this crosshatch using a knife, and then you're pulling at the coating with a piece of tape.
139
3833,000 - 3848,000
In this particular test, you can see a lot of the orange coating beneath, so we would probably say that this wasn't good enough adhesion between the gray coating and the underlying orange coating if you considered an overcoat.
140
3848,000 - 3900,000
You want to be sure you do a test patch. If you are going to move forward with this, use the ASTM D5064 method and do a test patch in that area.
141
3900,000 - 3911,000
The drawbacks for this is that the coating failure is possible after you've applied the coating you could have a delamination issue that you hadn't expected.

142
3911,000 - 3923,000
The other issue is that if you had lead-based paint or some other hazardous material on the structure, it remains on the structure and you'll need to pay for that abatement later on down the road.
143
3923,000 - 3944,000
Here are some examples of situations where we would recommend total removal on recoat. These examples were far beyond the 15 percent surface area that's damaged, and that 15 percent, you hear it over and over as a rule of thumb, where it becomes more economical to just replace the entire coating system.
144
3944,000 - 3950,000
Here we're showing a coal tar enamel that had approximately 70 years of service before we're removing it.
145
3950,000 - 4005,000
At the bottom left is a photo of a yellow flange butting up against a concrete wall. The corrosion cell led to degradation of that coating around that area.
146
4005,000 - 4007,000
The ideal maintenance cycle.
147
4007,000 - 4026,000
This begins every time you put a new coating on a structure, and the example on the bottom left shows that you might do your initial painting in year zero. A couple years later, maybe even eight years later, not always that long, you might be doing some spot repairs, maybe again a few years later.
148
4026,000 - 4037,000
If it's an atmospheric structure, you may be able to do a spot repair and overcoat at some point, but then eventually you get to the end of the cycle, and that's where you're doing the full re-coat.
149
4037,000 - 4059,000
The other thing to point out here is that there are some situations for immersion or buried structures where we can now use cathodic protection to extend the service life. That's something we typically consider when we're doing our inspections, is whether or not cathodic protection may be a feasible means of extending that service life of the coating.
150
4059,000 - 4102,000
The progression of a maintenance project.
151
4102,000 - 4125,000
This is if you're going to be doing some maintenance and writing a coating specification. You need to think very critically about the items that are going to be receiving the painting maintenance. Be sure that you're looking at the items that are adjacent to it, and insuring that if they need to be protected or treated separately, that you're stating that specifically in your specifications.

152
4125,000 - 4148,000
It could be mating your machine surfaces, mechanical or electrical equipment in the vicinity, or any other types of instructions or placards. If you're going to be writing a coating specification, there is a guide spec online for reclamation. Otherwise, we spend a lot of time in our group preparing coating specifications for project work.
153
4148,000 - 4200,000
We're always available if you need to call us and you are preparing your own specification. You want to ask us some specific questions, give us a call. Otherwise, there's always the contracting option, too.
154
4200,000 - 4216,000
We've been stressing more and more lately that during the construction support process, that while the contractor is on site, that there is someone that's performing quality assurance. We also like to see that the contractor has a good quality control plan.
155
4216,000 - 4227,000
We want to see that people are certified coating inspectors. There's a NACE CIP coating inspector program, certification, and there are other similar programs, too.
156
4227,000 - 4232,000
The developing a maintenance plan and strategies for doing so.
157
4232,000 - 4254,000
I just have two quick slides here where we talk about the funding. This is more like taking a step back, it's not the actual inspection itself, but it's more about thinking about the types of structures that you're responsible for and determining the funding source for performing maintenance on those structures.
158
4254,000 - 4309,000
If you have coated equipment, does the funding source for that maintenance cover regular inspections and repairs, and replacements? Also, you want to think about the different types of infrastructure that you have to protect.
159
4309,000 - 4331,000
Sometimes it's easier to understand the internal waterway of the hydroelectric power plant. Obviously, all of those structures are interfaced with water. We consider that to be a little bit more severe service environment. It's also more challenging to get in there and re-coat them, or perform coating maintenance, because of the limited outages.
160
4331,000 - 4344,000
You also want to think about the other types of structures or substrates that you might need to protect with the coating also, such as some concrete structures.
161
4344,000 - 4401,000

The photo here is showing a penstock interior. This is a steel liner that's in immersion exposure. It's almost always an immersion. The only time it's dry is when it's taken out of service.
162
4401,000 – 4418,000
Again, the exposure is at atmospheric burial immersion, or intermittent immersion. I'll always think about any special construction needs. What's the access? Do you have confined spaces? Are there strict outages?
163
4418,000 – 4439,000
The photograph here is showing a structure that's a radial gate. So it's intermittent immersion and UV exposure. You want to be sure that you're seeing that the coating and coat holding up well in the areas that are being immersed, but also that it's holding up well in the areas that are being exposed to UV. So looking for chalking, or any other degradation in those areas.
164
4439,000 – 4458,000
This is going to be a particularly challenging structure to re-coat, because it is over a water source. The complexity is added for that if there are any hazardous materials within that coating, because you want to be sure that you're protecting your water source during any maintenance that's performed.
165
4458,000 – 4518,000
That is the end of the Webinar on Coating Maintenance Assessment. Here is our contact, here in Denver. Myself, and we have four other colleagues, on the coating side, on the left, and our five corrosion colleagues on the right. If you have any questions for either of us, feel free to email or call...
p.